SEED COTTON DRIER FOR A MECHANICAL PICKER

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SEED COTTON DRIER FOR A MECHANICAL PICKER

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ABSTRACT

A nine-shelf stub drier installed on a two-row spindle picker satisfactorily dried seed cotton in Mississippi field trials. Moisture content was substantially reduced without adversely affecting seed cotton quality throughout the harvest season. A picker-drier system has the potential of increasing picking time and rate and decreasing harvest costs.

INTRODUCTION

Harvest operations are affected by excessive moisture in many areas of the Cotton Belt as a result of heavy dews, natural sap, and untimely rains. High moisture in seed cotton on the stalk prevents or reduces the maximum use of mechanical harvesters. Excessive moisture may also cause reduced lint and seed quality when seed cotton is stored before ginning. A drying method which eliminated excessive moisture would increase efficiency and profits.

It is estimated that mechanical pickers in the Mississippi Delta are operated an average of only 234 hours, or 26 picking days, per season. This relatively short harvest season, coupled with high machine costs and the limited output of mechanical pickers, results in a high fixed per-acre harvest cost. If unfavorable weather and moisture conditions could be circumvented, operational time could be extended and costs reduced. Therefore, a study was conducted whose aim was to lower the per-bale fixed cost by increasing the total hours the picker can be used.

It was determined that installing a drier on a mechanical picker will increase the number of safe picking hours per day, especially on days when dew would delay harvesting. By increasing harvesting time 22 percent to 286 hours (32 picking days) per season, the cost of harvesting could be lowered by as much as $2.33 per bale. A picker-mounted drier should also make safer the storage of machine-picked cotton in the field and the gin lot.

Franks and Shaw[5] showed in pipe-drying studies that seed cotton moisture evaporated very rapidly for the first 2 to 3 seconds at an initial temperature of 285° F, after which the drying rate was considerably reduced. They also found in cottonseed drying and storage studies that moisture is a critical factor in cottonseed quality.[6]

Parker and Clayton[7] investigated a drier-equipped cotton picker in 1961 and found that the drier tested did not remove a significant quantity of moisture from the seed cotton. They attributed its ineffectiveness to insufficient heat and exposure time and to a low-capacity fan.

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[5] Franks, G. N., and Shaw, C. S. 1962. Multipath drying at cotton gins for controlling moisture in cotton. U.S. Dep. Agric., Agric. Res. Serv. [Rep.] ARS–42–69, pp. 3–4.

[6] Shaw, C. Scott, and Franks, Gerald N. 1962. Cottonseed drying and storage at cotton gins. U.S. Dep. Agric. Tech. Bull. No. 1262, pp. 4–6.

[7] Parker, R. E., and Clayton, Joe E. 1961. Cleaning and drying with picker-mounted equipment. 1961 Annual Report, Southern Regional Cotton Mechanization Project S–2, pp. 364–371.

Parker and Wooten[8] showed that the principal cause of deterioration of seed cotton in storage was excessive moisture, resulting from weather conditions, green material in the harvested cotton, and moisture from the picker spindles.

Griffin and McCaskill[9] found that the moisture content of the cottonseed was a more reliable index of potential quality loss than seed cotton moisture content. In this study, lots that heated during storage yielded ginned lint of lower grades after storage than before storage. Riley and Williamson[10] found that excessive moisture in cotton causes a lowering in grade when the cotton is stored, even when there is little or no delay in drying and ginning.

LABORATORY STUDIES

Investigations to determine the feasibility of seed cotton drying in the field were begun at Stoneville, Miss., in spring 1970. Various experimental drying arrangements were compared in the Cotton Harvesting Laboratory before a field model was developed.

Since prior research by U.S. Cotton Ginning Research scientists at Stoneville had indicated that a minimum of approximately 3 seconds of exposure at a temperature of 220° F is required for any appreciable seed cotton drying, a nine-shelf stub tower drier was fabricated and tested in the laboratory. The drier shelves were connected with semicircular end pieces to allow cotton to flow in either direction in the drier. That is, the cotton could enter the bottom of the drier and exit at the top or vice versa, as the experimenter chose.

Heat was supplied by a 900,000 Btu, ventile inspirator, butane gas burner. Drier fuel was supplied from a 25-gallon auxiliary butane tank, and fuel volume was regulated by a high-pressure regulator. A John Deere 99 cotton picker fan supplied airflow for conveying cotton and heat. The cotton was fed into the system from a flat conveyor belt at the normal harvesting speed of 2.1 mi/h.

The laboratory experiments compared four systems of directing heated air into the cotton conveying system. (1) Heat was introduced into the fan on the negative side and blown into the drier, (2) hot air was pulled into the system on the positive side of the fan through a venturi-type opening, (3) an additional fan was used to force, or push, hot air into the drier, and (4) hot air and cotton were pulled through the drier and discharged through the fan. In all the drying experiments seed cotton test lots were spread out and sprinkled with water to obtain the desired moisture content. After the water was applied, lots were mixed by hand several times during a 24-hour moisture-equalization period. Lots were also kept covered to assure even diffusion of the moisture.

The first experimental drying system produced good seed cotton drying results. However, with a prolonged temperature of 230° F at the entrance of the drier, heat inside the picker fan housing was 248° F and resulted in fan bearing failure. Since it was not feasible to mount the bearings outside the fan housing, this system was eliminated.

The second system, which employed a venturi-type opening in the duct work on the positive side of the fan, proved successful when the duct discharged into the open air, but failed to operate effectively when connected to the drier. Resistance inside the drier increased when seed cotton was being conveyed and caused the failure.

In the third system, an additional fan and a grated duct were connected to the cotton conveying system. The additional fan was connected to the burner to allow hot air to be blown from the burner to the drier. Hot air entered the main airstream at the midpoint between the drier and the first fan. However, this system increased air volume to the extent that it was uneconomical to heat. It appeared that some of the air could best be removed by feeding the cotton through a conventional air-and-cotton separator and then directing it into the drier with a vacuum feeder, a system often used to introduce cotton into the hot-air lines in cotton gin driers. This method was not used, however, because of the additional machinery and costs involved. Instead, several grates were installed in the duct work of the main airstream to dissipate some of the air be-

[8] Parker, R. E., and Wooten, O. B. 1964. Sources of moisture in mechanically harvested seed cotton and its effects on cotton quality. U.S. Dep. Agric. Tech. Bull. No. 1313, pp. 9–16.

[9] Griffin, A. C., and McCaskill, O. L. 1964. Storage of seed cotton in trailers. U.S. Dep. Agric. Prod. Res. Rep. No. 81, pp. 15–18.

[10] Riley, J. A., and Williamson, E. B. 1959. Relative humidity in cotton fields at harvest time. Miss. Agric. Exp. Stn. Bull. No. 581, pp. 3–5.

fore it reached the drier. This approach proved successful for only a short period of time, since the grates soon became clogged with cotton, making it impossible for air to escape from the main airstream.

After three major changes, the fourth system proved to be the most successful. The changes involved (1) the position of the drier in relation to the fan, (2) the heated-air entrance to the driers, and (3) the cotton entrance to the drier (fig. 1). The drier was placed on the suction side of the fan, and heat was drawn into the drier at the cotton entrance point. Because the fan was far enough away from the entering heat to allow the heated air to cool considerably before reaching the fan bearings, this change eliminated bearing failure. Once this system was installed in the laboratory, the drier was subjected to tests to determine temperature distribution, air volumes, and amount of seed cotton drying. The temperature measurements showed no extreme hot spots in the system, and a gradual decrease in air temperature from the entrance to the exit of the drier. For example, when the average entrance temperatures was 220° F, the corresponding heat in the drier was 160° F at the second shelf, 134° F at the fifth shelf, and 104° F at the ninth shelf, or exit (fig. 2).

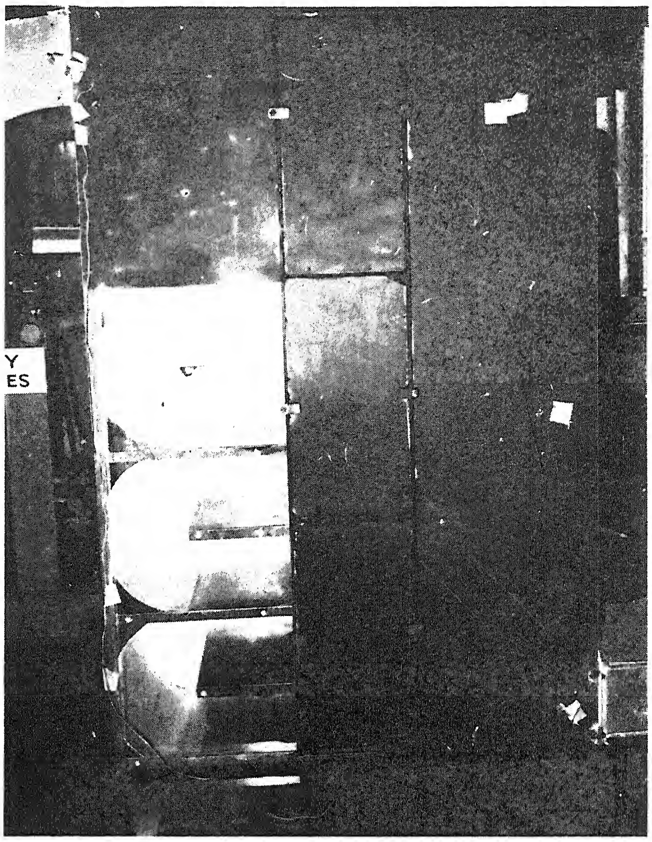

FIGURE 2.—Nine-shelf stub cotton drier. Temperature recording positions are covered with tape.

Seed cotton drying experiments were conducted in the laboratory with both dampened and undampened cotton. Tests were also conducted in which hot air entered the drier at the bottom of the suction duct and at the top (fig. 3). The undried samples were collected from the flat conveyor, and the dried samples were collected from a duct which was a small-scale model of the air and cotton separator used on a cotton plot picker. The dried samples were collected from the duct which extended from the fan, immediately after conveying (fig. 4). All samples were sealed in

FIGURE 1.—Laboratory cotton-drying system equipped with fan for drawing hot air and cotton through drier.

airtight cans and later subjected to ovendrying moisture tests.

Results of the laboratory studies are summarized in tables 1 and 2. In two series of drying tests with heat entering the suction duct at the bottom of the drier, good moisture removal was attained (table 1). Experiments were also conducted in which heat entered the top portion of the suction duct where the duct connects to the drier. Very satisfactory drying results were obtained in both of these experiments (table 2). In general, drying was increased when the hot air entered the top of the drier. The amount of moisture removed depended on initial moisture and the drier temperature used. Moisture removed was highest in the samples with the highest moisture content. These laboratory experiments with a specially designed shelf drier provided the basis for development of a picker-mounted drier.

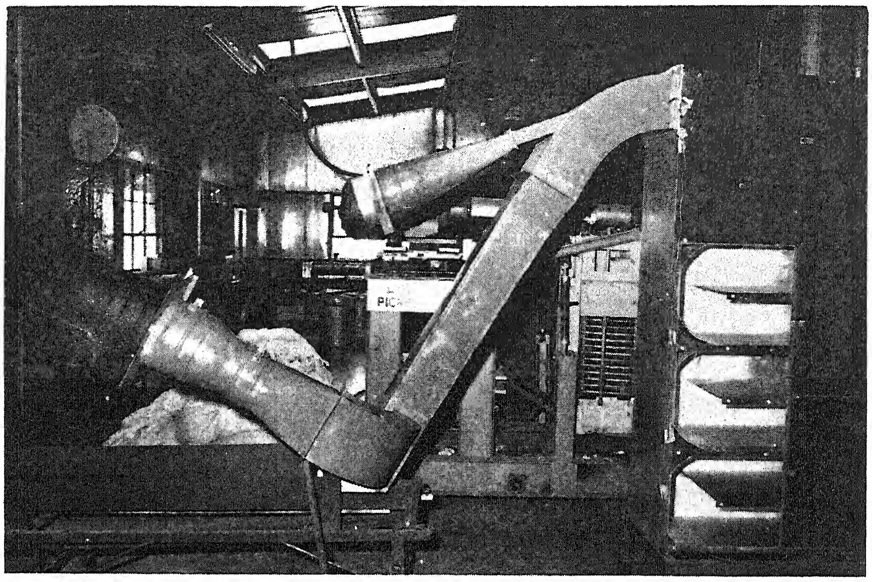

FIGURE 3.—Laboratory system for introducing heated air into drier at bottom of suction duct. Outlet at top of duct was used in further experiments.

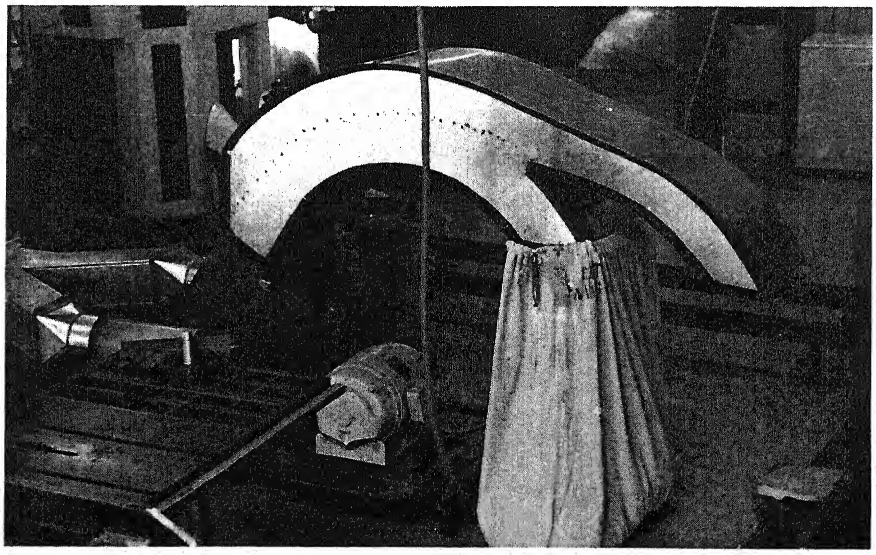

FIGURE 4.—Sampling station for collecting dried seed cotton samples.

TABLE 1.—*Moisture removed from seed cotton by a nine-shelf stub drier with hot air introduced at bottom of suction duct*[1]

Drier temperature (° F)	Dampened seed cotton			Undampened seed cotton		
	Moisture content (%)		Moisture removed (%)	Moisture content (%)		Moisture removed (%)
	Before drying	After drying		Before drying	After drying	
220	18.2	16.8	1.4	10.0	9.5	0.5
230	17.3	16.3	1.0	9.6	9.0	.6
250	16.2	15.0	1.2	9.4	9.2	.2

[1] Heat provided by a 900,000-Btu butane burner. Stoneville, Miss., 1970. Each value is the average of 3 samples.

TABLE 2.—*Moisture removed from seed cotton by a nine-shelf stub drier with hot air introduced at top of suction duct*[1]

Test and drier temperature (° F)	Dampened seed cotton			Undampened seed cotton		
	Moisture content (%)		Moisture removed (%)	Moisture content (%)		Moisture removed (%)
	Before drying	After drying		Before drying	After drying	
Test 1:						
210	14.6	13.4	1.2	9.5	8.6	0.9
220	13.1	13.0	.1	9.0	8.5	.5
230	12.3	11.3	1.0	9.0	8.8	.2
Test 2:						
210	18.9	16.6	2.3	...	...	...
220	17.3	15.1	2.2	...	...	...
230	16.4	13.8	2.6	...	...	...

[1] Heat provided by a 900,000-Btu butane burner. Stoneville, Miss., 1970. Each value is the average of 3 samples.

DEVELOPMENT AND EVALUATION OF FIELD DRIERS

Since the final design for the pipes and duct necessary to attach the nine-shelf stub drier to a two-row spindle cotton picker had not been completed in time for the 1971 harvest, the time remaining in the harvest season was used to conduct tests on a simplified hot-air pipe drier. Guided by results of the laboratory studies, the simplified pipe drier was fabricated and attached to a two-row spindle cotton picker (fig. 5). Hot air from a butane-burning heater was conveyed directly into one picking unit. No changes were made in the other picking unit.

The simplified drying system consisted of a 900,000-Btu heater, firing tube, regulator, and ducts. Combustion of gases took place inside a 48-inch section of 14-inch-diameter, 16-gage steel pipe. The firing tube was housed inside a 22-gage galvanized steel pipe, which was 16 inches in diameter and 58 inches long. The remainder of the pipe and the ducts were constructed from 22-gage galvanized steel. The pipe was reduced by transition from 16 to 10 inches in diameter, and subsequently from 10 to 6 inches, with the 6-inch-diameter pipe leading to the duct. The total length of pipe connecting the burner to the front drum was 14 feet. Twelve feet of pipe was required to conduct hot air to the rear drum. The heat was distributed to the front drum by attaching a 4- by 36-inch rectangular duct with a 6-inch flange to the 6-inch pipe. The positioning of the duct enabled the hot air to enter the front drum at a point adjacent to the doffers (fig. 6). The heated air was piped to the base of the rear drum through a 5- by 7-inch duct connected at the bottom of the main airstream (fig. 7).

Two separate experiments were conducted with the picker-mounted pipe drier in a field of 'DPL 16' cotton with an average yield of 1½ bales per acre. Ground speed of the picker was 2.1 mi/h for both tests. Data were obtained on

the moisture content of seed cotton from the stalk, from the picker-dried lots, and from the undried machine-picked lots.

The first experiment was primarily to determine if seed cotton could be dried on the picker without the nine-shelf stub drier. Temperatures of 125° and 175° F at the fan entrance were used in the initial trials. The test was conducted at 8:30 a.m., while a heavy dew was on the cotton. Relatively low butane pressures of 7 and 12 lb/in² were used for the 125° F temperature and the 175° F temperature, respectively. Samples were collected from the stalk and from the dried and undried machine-picked lots immediately after harvest. Since hot air was applied to only one row of the two-row picker, simultaneous sampling of both dried and undried machine-picked cotton was accomplished. All samples were sealed in airtight cans and subsequently dried in a conventional moisture-test drying oven to determine moisture content.

The second field-drying experiment was a more extensive study of the effect of field drying on evaporation of moisture in seed cotton. The

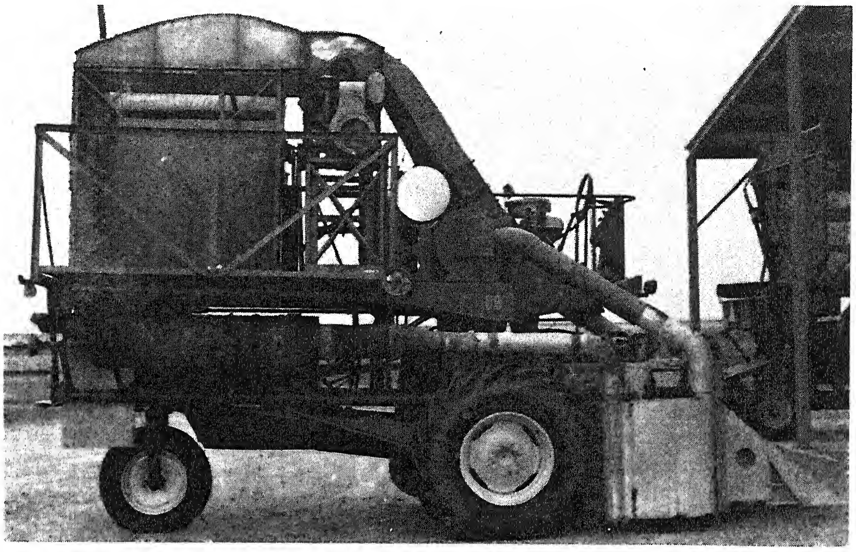

FIGURE 5.—Pipe-drying attachment mounted on an experimental two-row spindle cotton picker.

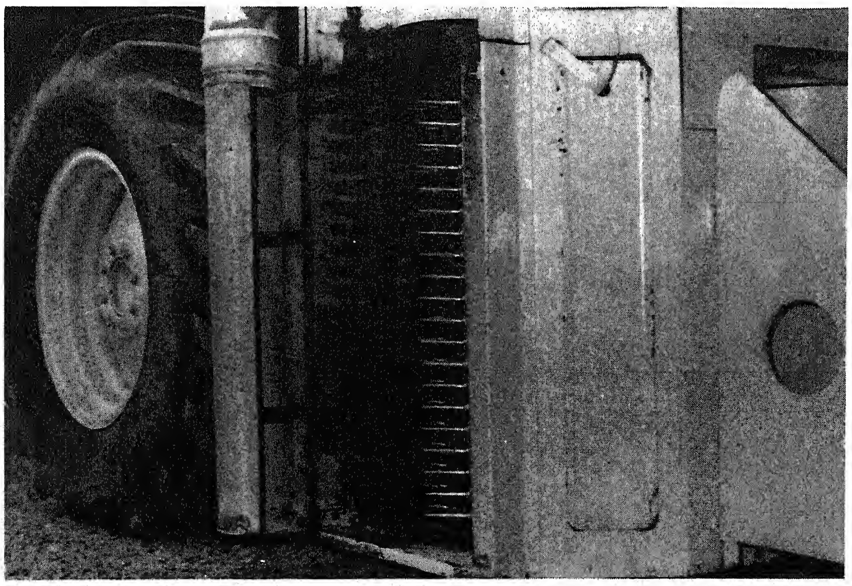

FIGURE 6.—Front-drum heating duct of spindle picker positioned to distribute hot air to doffing pads at the point where cotton is doffed from spindles.

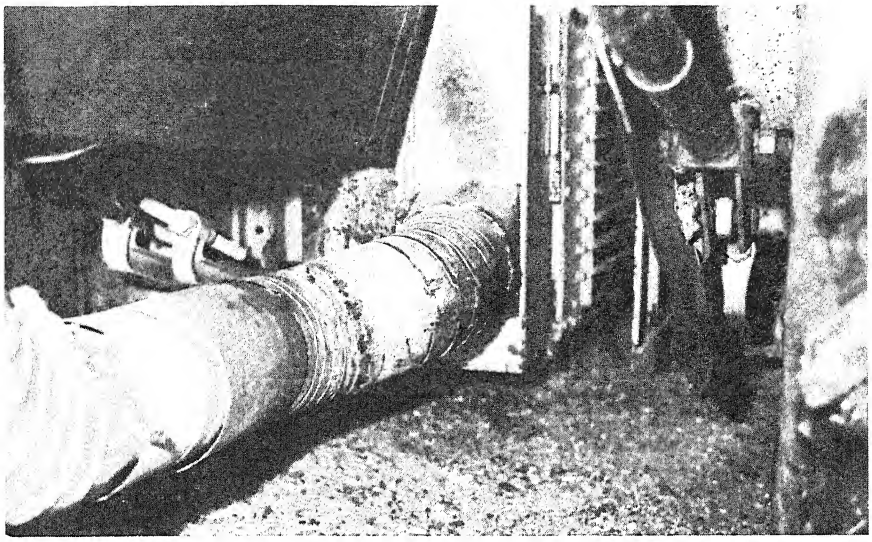

FIGURE 7.—Rear-drum heating duct as used on spindle picker.

harvesting and drying test was conducted in a field of 'Stoneville 7A' cotton on November 30, 1971. Drying-temperature measurements were obtained inside the picker head where the hot air mixed with the ambient conveying air. Temperatures of 180°, 150°, and 110° F were used in the field-drying studies. Criteria for evaluation included data on weather conditions, temperature of seed cotton (sampled 5 minutes and 30 minutes after conveying), seed cotton foreign-matter content, and lint foreign-matter content.

All lots of seed cotton received normal cleaning in the gin. The cotton was cleaned, in sequence, with the following equipment: a six-cylinder cleaner, a stick remover, a six-cylinder cleaner, a feeder, and two saw-type lint cleaners in series. One half of the field-dried cotton received further drying in the gin at 220° F, while the other half was processed without any further gin drying. Likewise, a portion of the undried field cotton was dried in the gin at 220° F and a comparable portion was left undried.

Seed cotton samples from the picker storage basket and from the feeder apron in the gin were analyzed for trash content. The foreign-matter components included hulls, sticks and stems, leaf, pin trash, and motes. Samples of the ginned lint were classed and tested for foreign matter and moisture content.

Results of the first field-drying experiment with the pipe drier are summarized in table 3. These data show that effective seed cotton drying was accomplished with the simplified drying attachment.

Drying results were poor in the second field-drying experiment, which was conducted on a very cool, overcast windy day (table 4). The ambient temperature was 46° F, relative humidity was 75 percent, and the wind ranged from 12 to 15 mi/h. The unfavorable drying conditions required the use of high butane pressures (16 to 22 lb/in^2) to properly heat the air inside the picker head. The high pressures in turn resulted in excessively long flames that extended far into the hot-air pipe. Sparks from the flame reached the cotton in the picking unit and set 3 of the 18 test lots afire; these 3 lots were discarded and 3 others obtained. Under the cool and windy conditions, drying results were not as good as had been hoped for, but it was observed that the tempera-

TABLE 3.—*Effect on seed cotton moisture content of mid-season[1] field drying with simplified pipe drier*

Drying temperature[2] (° F)	Seed cotton moisture[3] (%)		
	Stalk sample	Wagon sample: Undried	Wagon sample: Dried
175	16.2	16.0	13.4
125	16.0	14.3	12.9

[1] Stoneville, Miss., Oct. 1971.

[2] Temperature measured at fan entrance. The temperature of ambient air was 65°–70° F.

[3] Average of 3 samples.

ture of the cotton mass increased and was 12° F higher than the ambient temperature for as long as 5 minutes after sampling. Thus it is likely that additional drying occurred after the samples were taken.

The foreign-matter content of the wagon samples was not affected by the drying treatments. The field-dried seed cotton contained 4.2 percent total trash, and the field-dried plus gin-dried cotton contained 4.6 percent trash. Samples collected from the feeder apron had 2.3 percent total trash and were not affected by the drying treatments.

Classer's grade and staple length were not affected by the drying treatments. However, lint foreign-matter content was smaller in the field-dried samples than in the undried cotton (table 5).

FIELD EXPERIMENTS WITH NINE-SHELF STUB DRIER

In 1972, substantial progress was made in the development and adaptation of a nine-shelf tower drier for use on a two-row spindle cotton picker. Proper placement of the drier on the picker was a critical factor in development, since it was necessary to maintain a continual flow of seed cotton through the drying and conveying system. In the first experiments, the drier was placed on the negative-pressure side of the fan. With this arrangement, seed cotton and heated air were pulled from the picker head through the fan. However, resistance inside the drier greatly reduced air velocity in the system and stifled the pickup of seed cotton from the rear drum. The entrance of the rear-drum conveying pipe into the drier was moved several times in an effort to increase air velocity and eliminate cotton clogging. These moves increased air velocity to some extent, but the clogging was not completely eliminated. The problem was finally solved by moving the drier to the positive side of the picker fan. In this arrangement cotton was pulled from the picker head and blown into the tower drier (fig. 8). The arrangement increased air velocity inside the drier and reduced clogging in the rear drum. The heating equipment used in the pipe-drying experiments in 1970 was used to supply hot air to the nine-shelf drier.

Heavy rains that began in October and continued through the winter months delayed field testing of the drier until March 1973. In these late-season tests, field-drying temperatures of 100°, 125°, and 200° F were used at the fan entrance. Samples were collected and processed in the field and gin in the same manner as the 1970 samples.

The drying results summarized in table 6 indicate that moisture was added to the cotton during the spindle-moistening process in the harvester. The drying results then show that on an average the cotton was reduced in moisture by 0.5 percentage points by the drier.

TABLE 4.—*Effect on seed cotton moisture content of late-season[1] field drying with simplified pipe drier*

Drying temperature[2] (° F)	Seed cotton moisture[3] (%)		
	Stalk sample	Wagon sample: Undried	Wagon sample: Dried
180	12.9	12.4	11.3
150	12.6	11.9	11.4
110	12.0	11.8	11.6

[1] Stoneville, Miss., Nov. 30, 1971.
[2] Temperature measured at hot-air mixing point. The temperature of ambient air was 46° F.
[3] Average of 6 samples.

TABLE 5.—*Moisture and foreign matter in cotton from late-season field drying with simplified pipe drier[1]*

Drying temperature (° F)		Moisture content (%)				Foreign matter in lint (%)
Gin	Field	Wagon	Feeder	Lint	Seed	
220	Ambient	10.9	10.1	5.1	11.3	3.18
Ambient	Ambient	10.7	10.5	5.7	11.1	3.26
		10.5	9.5	5.1	11.0	2.99
		10.3	9.5	5.4	10.6	3.26

...ples. Stoneville, Miss., 1971. All samples classed Strict Low Middling (grade index of 94.0), with ...h.

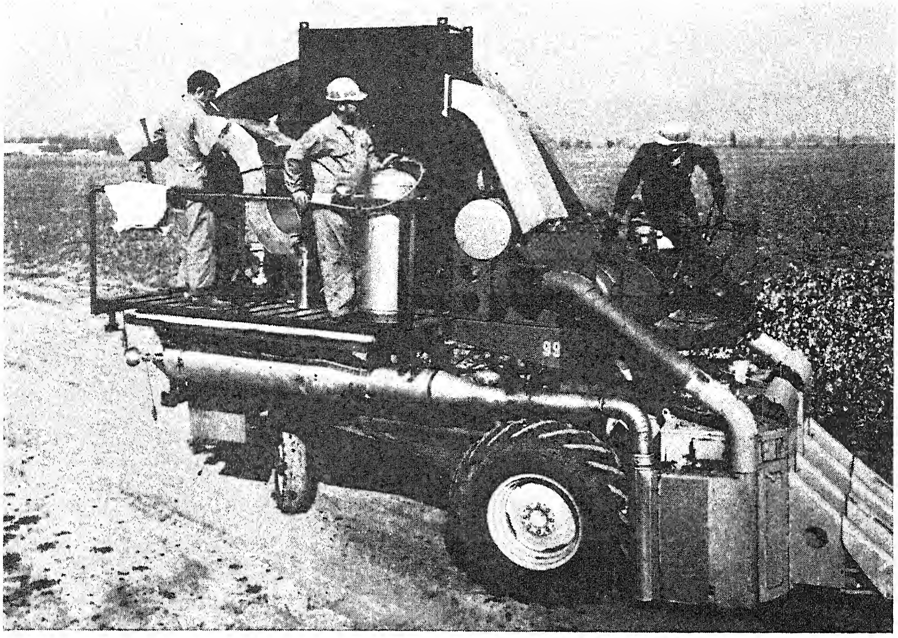

FIGURE 8.—Nine-shelf experimental drier mounted on a two-row mechanical cotton picker.

TABLE 6.—*Effect of late-season field drying on seed cotton moisture content*[1]

Drying temperature (° F)	Seed cotton moisture (%)		
	Stalk sample	Wagon sample	
		Undried	Dried
200	15.0	16.1	15.5
200	15.0	15.9	15.3
175	13.6	15.7	14.4
125	13.1	14.4	14.1
100	14.3	15.2	15.4
100	12.6	14.9	14.3

[1] Stoneville, Miss., 1972. Each value is the average of 3 samples.

In the late-season nine-shelf drier experiments, classer's grade and staple length were not affected by the drying treatments (table 7). All samples classed Strict Low Middling Light Gray (grade index value of 85.0), with a $1\frac{1}{16}$-inch staple length. Lint foreign-matter content tended to decrease when subjected to field drying plus drying at the gin.

Seed cotton foreign-matter content was analyzed and classified as hulls, sticks and stems, grass, leaf, pin trash, and motes. Together these components composed the total trash content. Samples for trash content were obtained from both the wagon and the feeder apron at the gin. The field-dried wagon samples were lower in total trash content than the undried samples. Field-dried samples also had a lower total trash content after gin drying than did the undried samples. Field drying had no effect on the trash content of the feeder-apron samples.

The fibrograph 2.5-percent span length and uniformity ratio were not affected by the drying treatments, nor did field drying affect the strength, micronaire, or neps content of cotton samples. Although field drying did not affect the colorimeter reflectance, the degree of yellowness tended to decrease with the lower field-drying temperatures. The higher field-drying temperatures tended to reduce the amount of visible cracked cottonseed in the wagon samples, but drying had no effect on cottonseed damage after ginning.

Two modifications were made in the drying system in 1973. The first, a fan installed behind the burner, resulted in an increase of hot air inside the drier, less heat loss in conveying, and a reduction in fuel consumption. The second modification involved moving the burner to the opposite side of the picker, which increased the distance from the open flame to the cotton and reduced the possibility of seed cotton fires

Two field-drying experiments were c
during late-season harvest operations,
on October 23, and the second on Dec

TABLE 7.—*Moisture and foreign matter in cotton from late-season field drying*[1]

Drying temperature (° F)		Moisture content (%)				Foreign matter in lint (%)
Field	Gin	Wagon	Feeder	Lint	Seed	
200	Ambient	15.5	12.7	7.1	16.2	2.97
200	220	17.4	12.9	6.5	16.9	2.12
175	Ambient	14.6	13.7	7.6	15.6	2.28
175	220	13.6	13.2	6.5	15.9	2.23
125	Ambient	13.3	13.3	7.1	16.1	1.94
125	220	13.5	12.7	6.6	16.3	2.20
100	Ambient	13.0	12.1	6.9	14.1	2.27
100	220	12.1	11.5	6.3	14.5	2.11
Ambient	Ambient	16.4	14.6	7.1	19.3	2.43
Ambient	220	15.7	14.0	6.6	18.5	2.31

[1] Average of 3 samples. Stoneville, Miss., 1972. All samples classed Strict Low Middling Light Gray (grade index of 85.0), with a 1$\frac{1}{16}$-inch staple length.

Testing procedures, sampling techniques, and ginning treatments were the same as those used in 1972. Field-drying temperatures of 150°, 175°, and 200° F were used at the fan entrance in both experiments. The field-drying results of these two tests are shown in table 8.

TABLE 8.—*Effects of early- and late-season field drying on seed cotton moisture content*[1]

Date and drying temperature (° F)	Seed cotton moisture (%)		
	Stalk sample	Wagon sample	
		Undried	Dried
Oct. 23:			
200	20.5	22.2	16.6
175	25.3	23.2	19.8
150	26.8	25.5	21.0
Dec. 18:			
200	9.5	10.6	9.2
175	10.0	10.5	9.0
150	10.0	11.2	9.7

[1] Stoneville, Miss., 1973. Each value is the average of 3 samples.

The field-drying test on October 23 began at 8:15 a.m., under extremely heavy dew conditions with stalk moisture as high as 26.8 percent. The initial ambient temperature was 60° F and relative humidity 77 percent. At the end of testing, the ambient temperature was 68° F and the relative humidity 63 percent. Temperatures of 150°, 175°, and 200° F were used in these drying experiments.

The desired drier temperatures were established prior to picking, but when the moisture-laden cotton passed through the drier, it was necessary to increase the fuel supply to the burner in order to maintain the initial drying temperatures. The field-dried cotton was reduced in moisture content by an average of 5.1 percentage points, a reduction of 7.9 percent of the total initial moisture content.

In the gin, both the field-dried and undried lots were processed with and without further drying. A temperature of 220° F was used for gin drying, and all cotton lots were subjected to normal cleaning in sequence, with the following equipment: a six-cylinder cleaner, a stick remover, a six-cylinder cleaner, a feeder, and two saw-type line cleaners in series. The samples taken at the gin show that field drying reduced lint moisture at all temperatures except at 150° F and that gin drying further reduced lint moisture in all cases. The classer's grade was higher at 200° F and 175° F than at 150° F.

Cotton which had been field-dried only graded slightly higher than cotton which was first field dried than gin dried as well. Staple length was 1$\frac{1}{16}$ inches and was not affected by drying treatments. With the higher drying temperatures, reflectance was higher and degree of yellowness lower (table 9).

In the late-season field-drying test, samples were collected and processed as they had been done in the earlier test. During this period, ambient temperature was 44° F, wind was at 9 mi/h, and relative humidity was 42 percent. Testing began at 8:50 a.m., with very little or no dew on the cotton. The drying temperatures of 150° and 175° F were obtained with low butane pressures

TABLE 9.—*Moisture content, grade, staple length, colorimeter reflectance, and yellowness of cotton from early-season field drying*[1]

Drying temperature (° F)		Moisture content[2] (%)				Classification[3]		Colorimeter[5]	
Field	Gin	Wagon	Feeder	Lint	Seed	Grade index[4]	Staple length (32ds in)	Percentage reflectance (R_d)	Degree of yellowness ($+b$)
200	Ambient	15.2	12.8	6.0	15.7	94	34	71.0	8.6
200	220	15.5	11.3	4.9	14.3	93	34	71.5	8.6
175	Ambient	18.5	14.5	6.3	16.6	94	34	69.6	8.8
175	220	18.4	13.6	5.4	16.3	92	34	70.4	9.0
150	Ambient	21.7	16.2	7.0	18.1	90	34	67.4	9.1
150	220	22.4	15.1	5.8	18.1	89	34	67.2	9.5
Ambient	Ambient	24.1	16.3	6.9	16.1	89	34	66.9	9.2
Ambient	220	24.0	15.4	5.6	18.1	87	34	65.9	9.9

[1] Stoneville, Miss., 1973.
[2] Average of 3 samples.
[3] Average of 6 samples.
[4] 94 = Strict Low Middling. 89 = Strict Low Middling Light Spotted.
[5] Percentage light reflectance (R_d) and degree of yellowness ($+b$) measured by a Nickerson-Hunter cotton colorimeter. Average of 3 samples.

of 8 and 12 lb/in^2 respectively, and required no additional fuel when the relatively dry cotton flowed through the drier. The 200° F temperature required 18 lb/in^2 of butane pressure, but fuel had to be adjusted to maintain the desired temperature. Ambient temperature and wind velocity had no apparent effect on the amount of fuel required for drying. Field drying reduced moisture in seed cotton by an average of 1.46 percentage points, which is a removal of 8.6 percent of the total initial moisture content of the undried wagon sample.

Seed cotton moisture in the field was lower than that of the late-season wagon samples, which indicates that moisture was added during the spindle-moistening process. The feeder-sample and seed-sample data show that field drying and gin drying reduced the moisture content in these samples. In some instances lint moisture was increased by drying, which could have resulted from wet spots in the cotton attributable to 0.06 inch of rain on the day of harvest.

Field drying increased the grade index of cotton from 85 to an average of 92. The cotton staple length of $1\frac{1}{16}$ inches was not affected by drying. Reflectance was higher as field-drying temperature increased, but the degree of yellowness was not affected by drying (table 10).

CONCLUSIONS

Field-drying experiments with a picker-mounted pipe drier indicated significant amounts of moisture can be removed from seed cotton under favorable weather conditions. However, the pipe drier did not perform satisfactorily in cold weather under windy conditions.

In 1972 and 1973 work with a nine-shelf tower drier showed that a picker-drier can remove substantial amounts of moisture from seed cotton during harvest, especially when the cotton is high in surface moisture content from dew. These data also show that during periods of heavy dew daily picking time may be increased by as much as 4 hours with a picker-mounted drier. With an average picker performance rate of 0.79 hour per acre, the picker-mounted drier could increase lint harvests by 7.16 bales per day (average of 680 pounds per acre) during a 4-hour period. If the average daily picking time were increased only 1 hour per day, the cost of harvesting could be lowered approximately 1 cent per pound. In addition to increasing daily picking time, field drying would permit more machine-picked cotton to be stored at a safe moisture level both in the field and on trailers at the gin.

TABLE 10.—*Moisture content, grade, staple length, colorimeter reflectance, and yellowness of cotton from late-season field drying*[1]

Drying temperature (° F)		Moisture content[2] (%)				Classification[3]		Colorimeter[5]	
Field	Gin	Wagon	Feeder	Lint	Seed	Grade index[4]	Staple length (32ds in)	Percentage reflectance (R_d)	Degree of yellowness ($+b$)
200	Ambient	9.0	8.2	6.5	9.8	94	35	70.0	7.1
200	220	10.5	7.8	9.3	9.6	92	34	70.9	7.2
175	Ambient	9.0	8.6	9.1	10.1	92	34	68.8	7.0
175	220	10.1	8.3	6.7	9.9	94	34	70.0	7.2
150	Ambient	9.9	8.9	9.3	10.2	90	34	67.1	7.3
150	220	10.1	8.0	5.2	9.8	92	34	68.5	7.2
Ambient	Ambient	10.3	9.5	5.3	10.6	85	34	67.5	7.2
Ambient	220	10.2	8.3	7.8	10.3	92	34	69.0	7.2

[1] Stoneville, Miss., 1973.
[2] Average of 3 samples.
[3] Average of 6 samples.
[4] 94=Strict Low Middling. 92=Middling Light Gray. 85=Low Middling.
[5] Percentage light reflectance (R_d) and degree of yellowness ($+b$) measured by a Nickerson-Hunter cotton colorimeter. Average of 3 samples.

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